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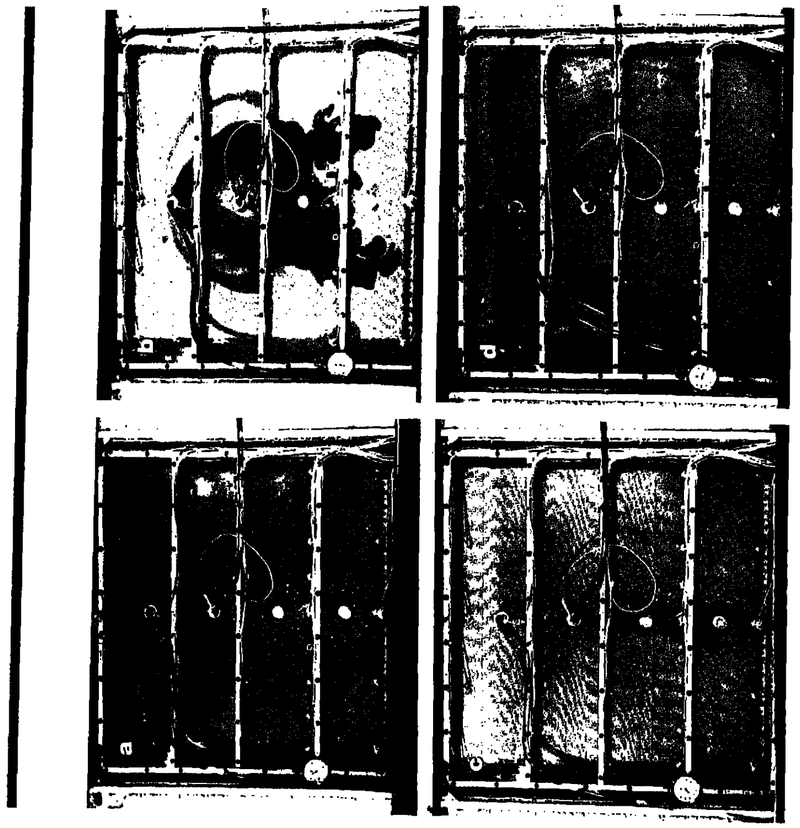


News

Elastic Lenses in the Earth

Seismic waves in the earth's crust and mantle are known to be sensitive to density contrasts over large volumes of rock, which contrasts tend to cause focusing effects. The end results of such effects observed at seismograph stations are hard to detect unless sufficient arrivals are sampled. It is a common fault to confuse such effects with those of local structures and properties. In a study of teleseismic, short-period (1 s) *P*-wave traveltime residuals and variations of amplitudes in western North America, R. Butler of the Hawaii Institute of Geophysics has found a high level of correlation to which he attributes qualitatively the focusing and defocusing of seismic waves (*Nature*, December 15, 1983). The correlation indicating that slow travel times relate to higher, and fast travel times to lower, amplitudes of seismic waves measured in western North America. Conversely, faster travel times and higher amplitudes are generally observed in eastern North America (defined as stations located east of the Rocky Mountain front). Although there may be less attenuation of seismic waves in the upper mantle beneath eastern North America, indications are that the degree of attenuation is highly variable. According to Butler, "On the large scale, the variations between western and eastern North America are probably rooted in lateral differences in temperature. Higher temperatures beneath the tectonically active west produce higher attenuation of *P*-waves, lower velocities in the upper mantle, and high surface heat flow." The focusing and defocusing effects of low and high velocity lenses, respectively, may be most effective if such lensese are located close to a seismic station. Butler noted that lenses, or anomalous regions, must have dimensions of one or more wavelengths of a *P*-wave, which translates to a minimum dimension in the earth of 6–8 km (for 1-s period waves). Positive correlations have been observed characteristically over large seismic arrays, suggesting the existence of lenses of several tens of square kilometers in cross section.

The elastic focusing effects observed in western North America for *P*-waves are observed for S-waves as well. Likewise, the lack of a systematic relationship is noted in eastern North America. Cause is attributed to differences in tectonic activity between the eastern and western portions of the continent.—*PAB*

Geo-Biosphere Proposal

An international, interdisciplinary program to study the closely coupled system of the terrestrial environment and the life that inhabits it has been proposed for later this decade. As currently outlined, the International Geosphere-Biosphere Program (IGBP) would encompass at least a decade of research and would involve a host of nations. IGBP would embrace studies of physical, biological, and ecological processes. The program, which will focus on global change, will be one of the major topics of discussion this fall at the General Assembly of the International Council of Scientific Unions (ICSU).

Development of the concept for IGBP was spearheaded by Herbert Friedman, chairman of the National Research Council (NRC) Commission on Physical Sciences, Mathematics, and Resources. Following an informal discussion of the program 1 year ago, Friedman publically suggested the international program in April 1983 at the annual meeting of the National Academy of Sciences at a symposium marking the silver anniversary of the International Geophysical Year (IGY). Three months later, the U.S. National Research Council (NRC) gathered more than 40 scientists, government officials, and NRG staff at a workshop in Woods Hole, Mass., to consider the major problems for research in five areas that might be coordinated in IGBP: the atmosphere, oceans, lithosphere, biosphere, and the solar-terrestrial system.

Global change was the unifying theme of the workshop, which Friedman chaired. "Of pressing importance is the need to understand the often deleterious effects of modern man on natural processes, such as the inevitable climatic impact of carbon dioxide loading of the atmosphere since the industrial revolution," writes Friedman in the preface to workshop's report. "Progress in understanding global change will require extensive and well-organized observations made over much of the earth and over a long period of time. The scope of such an effort requires international cooperation and interdisciplinary emphasis," he added. "Coordinated efforts between adjacent scientific disciplines and programs of synoptic observations focused on common, interrelated problems that affect the earth as a whole" are needed.

"A major challenge to an IGBP will be that of understanding the causes and effects of climate change," the workshop report states. "Variations in the earth's climate appear to follow from a long and convolved set of interactions including human and other biological activity, solar radiation, volcanism, ocean circulation, polar ice and land effects, and the chemistry and dynamics of the atmosphere itself."

ICSU will consider the NRC proposal at the ICSU meeting in Ottawa, Canada, September 24–28. A 1-day symposium will focus on the rationale, possible themes, and potential activities of such an international program to study global change. Commissioned papers will summarize scientific developments over the past 25 years and assess future prospects for illuminating the interactions of the geosphere and biosphere. For additional information, contact either of the two convenors: Thomas F. Malone (Unit 203, 5 Bishop Rd., West Hartford, CT 06119) or Juan G. Roederer (Director, Geophysical Institute, University of Alaska, Fairbanks, AK 99701). ICSU is an international, nongovernmental scientific organization composed of 18 scientific unions. The International Union of Geodesy and Geophysics is a member of ICSU.

Before the September meeting, though, the NRC will try to discuss the proposal in as many forums as possible, Friedman told *Eos*. Another workshop will be held in June to examine in more detail possible IGBP programs. In addition, Friedman said there will be an attempt to set up a symposium at the 1984 AGU Spring Meeting in Cincinnati, May 14–18.

Several years of planning would be required before the proposed program could actually get under way. Much of this planning would involve coordinating the nearly 30 observing and monitoring programs already in existence or being planned. Such programs—including, to mention only a few, the Global Atmospheric Research Program, Tropical Oceans and Global Atmosphere, World Ocean Circulation Experiment, Upper Atmosphere Research Satellite, Origins of Plasmas in the Earth's Neighborhood, and the International Geological Correlation Program—focus too narrowly to understand the interplay, the NRC workshop report states; it says that to link the problem areas of the geosphere and biosphere the scope of these programs must be strengthened and extended.

A new NRC committee on the IGBP, chaired by Jack Eddy of the National Center for Atmospheric Research, will hold its first meeting in March. Other NRC boards and committees dealing with related sciences are being asked to initiate discussions of their own to feed information to Eddy's committee, Friedman said.

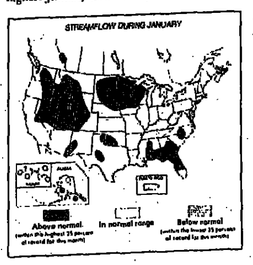
Copies of the Woods Hole workshop report, *Toward an International Geosphere-Biosphere Program: A Study of Global Change*, are available in limited supply from the National Research Council, Commission on Physical Sciences, Mathematics, and Resources, 2101 Constitution Ave., N.W., Washington, DC 20418.—*BTR*

January Streamflow

After a wet December that produced record high streamflows in many states, flows generally decreased during January, although many streams in the Gulf Coast region and the West were still flowing at rates well above average for this time of year, according to the regular monthend check of national water conditions by the U.S. Geological Survey (USGS).

USGS hydrologists said that only 35% of the 171 key index gaging stations across the country reported streamflows that were well above average during January. In contrast, 73% of these key gaging stations had reported well above average flows in December. The number of stations reporting well below normal flows increased from 13 stations (7%) in December to 25 stations (14%) in January.

Record or near record high flows were set at USGS stations in Colorado, Idaho, Minnesota, Montana, North Carolina, and Utah. The flow of the Snake River near Heise, Idaho, for example, averaged 10.2 billion liters per day (bld) (2.7 billion gallons a day), the highest January flow in 75 years. Flow of the Mississippi River at St. Paul, Minn., averaged 21.6 bld, the third highest January flow since recordkeeping began at that station in 1892.



The combined flow of the nation's three major rivers—Mississippi, St. Lawrence, and Columbia—reflected the general decrease in January streamflow. Decreases in the average flows of the Mississippi and St. Lawrence rivers for the month more than offset a large increase in the flow of the Columbia River. Their combined average flow of 2.313 bld was down 30% from last month and 2% below the long-term average. These three rivers, which drain more than half of the lower 48 states, provide hydrologists with a quick, useful check on the nation's water resources.

Hydrologist Hai Tang of the USGS National Center in Reston, Va., said that reduced precipitation in January contributed to the decreased streamflows. He noted that severe cold weather in many areas caused ice jams that produced localized flooding in Idaho and low-lying areas in Iowa. Other lowland floods occurred in the South Atlantic, Gulf Coast, and Pacific Northwest states. At month's end, an ice jam about 900 km in length existed on the Missouri River above Jefferson City, Mo.

Groundwater conditions were mixed during January. The levels in most key index wells were average to above average for the month. Wells in California, Maine, Nebraska, and Nevada reached record-high levels for January. Groundwater levels rose in most deep wells in irrigated areas in Nebraska, reflecting a seasonal recovery from irrigation withdrawals. Two key index wells near Ewing and Dunning reached their highest January levels in 50 years of record. Although the water level in a key index well in the El Paso, Tex., area rose during January, the level near month's end was still nearly 5 m below average for this time of year, and the lowest January level in 20 years of record. Index wells in Georgia, and parts of Iowa and Louisiana showed groundwater levels below the long-term average.

Average flows of the nation's five largest rivers were down substantially from December, with only the Columbia River showing an increase from last month. Flows of the "Big Five" rivers were: Mississippi River at Vicksburg, Miss., 1,370 bld, 13% below average and 43% less than the flow in December; St. Lawrence River at Massena, N.Y., 583 bld, 4% above the monthly average, but a decline of 10% from December; Columbia River at The Dalles, Ores., 360 bld, 70% above the long-term January average and an increase of 55% from December; Ohio River at Louisville, Ky., 246 bld, 6% below the January average and a decline of 51% from the previous month; and the Missouri River at Hermann, Mo., 125 bld, 51% above the January average, but down 40% from the December flow.

Fellowships in India

In an effort to encourage stronger research ties between India and the United States, the Indo-U.S. Subcommission on Education and Culture is offering 12 long-term and 9 short-term research fellowships in India in 1985 and 1986. The only requirement is that the applicants be U.S. citizens at the postdoctoral or equivalent postdoctoral level. The awards have no restrictions as to field of study, and because the program seeks to open new channels of communication between academic and professional groups in the two countries, those who have had little or no experience in India are especially encouraged to apply.

The long-term fellowships are for 6 to 10 months, with a monthly allowance of $1500. Long-term fellows will also receive travel money and allowances for dependents. The short-term awards, for periods of 2 to 3 months, also offer a monthly payment of $1500. Funding for these fellowships is provided by the U.S. Information Agency, the National Science Foundation, the Smithsonian Institution, and the Government of India.

Applications for the program must be received by June 15. Forms and further information are available from the Council for International Exchange of Scholars, Attention: Indo-American Fellowship Program, 11 Dupont Circle, Suite 300, Washington, DC 20036; telephone: 202-833-4985.

Forum

Geologic Research Opportunities

I read with great interest the recent account in *Eos* of the National Research Council's Board of Earth Sciences (BES) report on "Opportunities for Research in the Geological Sciences," and find the report to be an excellent summary of exciting research areas in continental geology (*Eos*, December 20, 1983, p. 985). However, the title of the report implies that the earth sciences as a whole are treated, and as such the report is plagued by several glaring omissions. It is important that these omissions be recognized because, as mentioned in *Eos*, this report will be used by government administrators to set priorities for future emphasis in federal funding.

The neglected topics include marine geology and geophysics, plate tectonics, paleoceanography, and paleoclimatology. Ironically, these may have been neglected because research in these areas has been so successful in the last 2 decades. As an aftermath to the extraordinary breakthrough related to marine geology and plate tectonics in the 1960's and 1970's, there has developed an atmosphere that I call the "post-plate-tectonic blues." Indeed, the discovery and verification of plate tectonics is a tough act to follow, and so it is natural for the pendulum to swing toward important problems in continental geology. While such a swing is an understandable response to the last 2 decades, it is dangerously short sighted.

Developments in marine geology and in plate tectonics in particular have provided a unified theory for the understanding of many heretofore seemingly unrelated geologic phenomena. As a unifying concept in the geological sciences, it is similar to the theory of evolution in the biological sciences. Nearly 100 years later, research is still vigorous in refining ideas and discovering new areas in evolution and genetics. In fact, evolution of life is listed as one of the eight major research areas in the BES report. In a similar way, 20 years later, important areas remain to be studied in marine geology and plate tectonic theory. The broad-based acceptance of plate tectonics as a theory does not mean that research in this area is waning, anymore than the acceptance of evolution as a theory signals the demise of research in that area. On the contrary, marine geology and geophysics remains among the most exciting research areas in the earth sciences and is undergoing something of a Renaissance owing to the development of new technologies such as SEA BEAM and SEA MARC I and II. It is a youthful and growing field in which exploration is still a key activity (for example, the discovery of black smoker vents, propagating rifts, and overlapping spreading centers, to name only a few).

The otherwise excellent BES report should either be retitled "Opportunities for Research in Continental Geology," or it should be amended to include the rather critical omissions in the areas of marine geology and plate tectonics research.

Ken C. Macdonald
Department of Geological Sciences
University of California
Santa Barbara, CA 93106

Reply

In response to Professor Macdonald's letter regarding *Opportunities for Research in the Geological Sciences*, I would like to point out the following considerations.

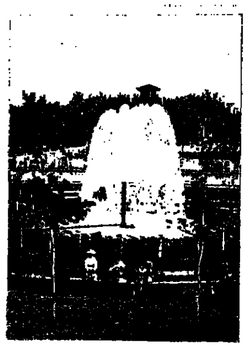
1. The report itself states on page 1 that it "examines those research opportunities that are pertinent to the programs of the National Science Foundation's Division of Earth Sciences."

2. Marine Geology and Geophysics (Section F, p. 59 of the report) is one of the five research areas identified in chapter 3 of the report as offering major opportunities and challenges for future research in the geological sciences. The other four areas are: surface and near-surface processes and the environment, continental blocks; earth's interior; and earth in the solar system.

3. On page 39, the report further states that, "Because marine geology and marine geophysics are not funded through the Earth Sciences Division, extensive discussion is not presented here. The opportunities in these areas have been described in the *COSOD, Ocean Crustal Dynamics* and *Continental Margins* reports."

William R. Dickinson
Chairman
NRC Commission
on Physical Sciences, Mathematics,
and Resources

WaterWatch



WaterWatch
Award of the hydrologic author

Editor: Mary P. Anderson, Department of Geology and Geophysics, University of Wisconsin–Madison, Madison, WI 53706. (608) 262-2390

Horton: Award, Medal, and Grant

Peter S. Eagleson

In the January 17, 1984, issue of *Eos* (p. 22), you will find the citation and acceptance of the 1984 winner of the Robert E. Horton Award, David A. Woolhiser. This edition of WaterWatch contains a listing of past winners of both the Horton Award and the Horton Medal. In addition there is a call for proposals for the 1984 Horton Research Grant. That's a lot of Horton, and experience has shown it to generate considerable confusion. Here I hope to clarify matters by drawing upon the historical research of our past president, James R. Wallis.

In 1945 the Hydrology Section first formally recognized contributions to the science of hydrology. This was done using two awards, a "best paper by a young author" award which was first given to Henry Anderson in 1947, and an award for the most outstanding contribution to the science of hydrology published in the *Transactions* during the preceding year. In 1948 Vincent J. Schaefer was its first winner. These awards were not given every year and during the period 1952–1955 there was not even a mention of them in the minutes of the section.

Robert E. Horton Award

In 1955 Section President Harold G. Wilm suggested use of the Horton Fund to cover the cost of an award certificate and, with AGU Council approval, the Horton Award was born. It has been given each year since 1956. From time to time the criteria and method of selection have been modified by the section executive. The current guidelines for granting of the Hydrology Section's Horton Award are as follows.

Basis

The award is to be given for a single outstanding contribution to the science of hydrology made during the preceding 5 years. The contribution may be (1) a single outstanding paper published in any journal; (2) a series of papers which, taken together, define an outstanding contribution; (3) a service to the science which makes an outstanding contribution, e.g., an outstanding meeting leading to a change in the science; (4) any other contribution which the nominating committee considers worthy.

Nominations

Nominations for the award will be taken from any member of AGU. They must be accompanied by a written statement which gives the basis for nomination.

Eligibility

Any member of the scientific community is eligible for the award. However, no one individual may receive the award more than once. The selection committee will have discretion for jointly authored work in which one author has already received the award.

Robert E. Horton Research Grant

Finally, the Horton Research Grant was established in 1982 as a Hydrology Section award. It uses income from the Robert E. Horton Fund to make a single, annual, competitive research grant to a graduate student in hydrology at an American university. The first grant was awarded to Jane Stockman of Stanford University in 1983. I recommend that the next section executive give consideration to changing the name of this award to remove some of the confusion.

Peter S. Eagleson, president of the AGU Hydrology Section, is with the Massachusetts Institute of Technology.

Robert E. Horton Award Winners

The Robert E. Horton Award is given annually by the AGU Hydrology Section for a single outstanding contribution to the science of hydrology made within the last 5 years. The 1983 award winner is David A. Woolhiser for his contributions in the area of kinematic modeling of surface water runoff and overland flow (*Eos*, January 17, 1984, p. 22). Previous winners of the award are listed below.

Precursor Awardees

a = best paper by a young author

b = best hydrology paper appearing in *Transactions* of preceeding year

Henry W. Anderson (1947a), Vincent J. Schaefer (1948b), Gordon Chapman (1949a), R. A. Work (1949b), Donald Kirkham (1951a), Heinz F. Poppendrick and Myron Trilos (1951b).

Horton Awardees

Charles L. Hosher and C. Robert Hosher (1956); W. J. Kaufman and G. T. Orlob (1957); John R. Philip and Daniel A. deVries (1958); W. B. Langbein and S. A. Schum (1959).

J. C. I. Dooge (1960); J. Weertman (1962); I. G. Donaldson (1963); Andrew E. Reisenauer (1964).

Floyd A. Hutt and Stanly A. Changnon, Jr. (1965); James R. Wallis (1966); C. H. M. van Bavel (1967); M. C. Matalas (1968); G. F. Pinder and John D. Bredehoeft (1969).

S. P. Neuman and P. A. Witherspoon (1970); R. Allan Freeze and James Banner (1971); Chih Ted Yang (1972); R. Allan Freeze (1973); J. Amorocho and B. Espildora (1974).

Ignacio Rodriguez-Iturbe and Jose M. Mejia (1975); Roland W. Jeppson; Walter J. Rawls, Russel Ramon, and David L. Schrieber (1976); Eric F. Wood (1977); Hsieh W. Shen (1978); Peter S. Eagleson (1979).

Samuel C. Colbeck (1980); Rafael L. Bras (1981); Lynn W. Gelhar (1982); David A. Woolhiser (1983).

Other Awards

Robert E. Horton Medal

In contrast, the Robert E. Horton Medal is a Union award given in even-numbered years upon recommendation of a subcommittee of the Union's Fellows Committee. It was first awarded in 1976 to the late Walter B. Langbein. The other winners to date are Harold A. Thomas, Jr. (1978); William C. Ackermann (1980); and John R. Philip (1982).

William Bowie Medal

The William Bowie Medal is presented annually to recognize outstanding contributions to fundamental geophysics and for unselfish cooperation in research. The first award was made in 1939 to William Bowie. Three hydrologists have received the award: Oscar Edward Meinzer (1943); Johannes Theodour Thijsse (1958); and Walter B. Langbein (1969).

James B. Macelwane Award

The James B. Macelwane Award is given to recognize the achievements of young scientists (less than 36 years old). Awards are made annually for significant contributions to the geophysical sciences to young scientists of outstanding ability. The first award was made in 1962. Three hydrologists have received the award: R. Allan Freeze (1973); Ignacio Rodriguez-Iturbe (1977); and Rafael L. Bras (1982).

Fellows

AGU also provides recognition to leaders in the field of geophysics through the election of Fellows.

The current AGU Fellows from the Hydrology Section are listed below:

William C. Ackermann, Henry W. Anderson, R. H. Beij, John D. Bredehoeft, Arthur Casagrande.

Peter S. Eagleson, Allan R. Freeze, John C. Frye, John C. Geyer, E. E. Harbeck.

Max A. Kohler, Luna B. Leopold, Ray K. Linsley, S. W. Lohman, Nicholas C. Matalas, Mark F. Meier.

Dean F. Peterson, George P. Rigsby, Ignacio Rodriguez-Iturbe, Philip C. Rutledge, Waldo E. Smith.

Charles V. Theis, J. Thijsse, Harold A. Thomas, David K. Todd, Gilbert F. White, M. G. Wolman.

1981: J. C. I. Dooge, J. R. Philip.
1982: W. Brutsaert, P. Witherspoon, J. Weertman, R. Bras.
1983: Jacob Rubin, Lynn Gelhar, James R. Wallis.

Horton Research Grant Posposals Sought

The American Geophysical Union is requesting proposals for the award of the Horton Research Grant. The proposal deadline is March 15, 1984. The grant will be in support of research projects in hydrology and water resources by Ph.D. candidates of American institutions of higher education and is awarded annually to a single proponent. Its objective is to foster graduate student research leading to the completion of doctoral dissertations. Proposals may be in hydrology (including its physical, chemical, or biological aspects) or in the water resource policy sciences (including economics, systems analysis, sociology, and law).

Proposals must be signed by both the student and the faculty research supervisor and must be received at the address below on or before March 15, 1984. The award will be in the amount of $5,500 and will be made directly to the winner, selected by a committee of AGU's Hydrology Section during the 1984 AGU Spring Meeting. For a detailed description of the grant and a guide for proposers, write to

Horton Research Grant
American Geophysical Union
2000 Florida Avenue, N.W.
Washington, DC 20009

Information Report

Data Harmonization and Model Performance

The Joint Committee on Urban Storm Drainage of the International Association for Hydraulic Research (IAHR) and International Association on Water Pollution Research and Control (IAWPRC) was formed in 1982. The current committee members are (no more than two from a country): B. C. Yen, *Chairman* (USA); P. Harremoes, *Vice Chairman* (Denmark); R. R. Price, *Secretary* (UK); P. J. Colyer (UK), M. Desbordes (France), W. C. Huber (USA), K. Krauth (FRG), A. Sjoberg (Sweden), and T. Sueishi (Japan).

The IAHR/IAWPRC Joint Committee is forming a Task Group on Data Harmonization and Model Performance. One objective is to promote international urban drainage data harmonization for easy data and information exchange. Another objective is to publicize available models and data internationally. Comments and suggestions concerning the formation and charge of the Task Group are welcome and should be sent to: B. C. Yen, Dept. of Civil Engineering, Univ. of Illinois, 208 N. Romine St., Urbana, IL 61801.

In addition to the Joint Committee there is also an informal group of interested people, known as the International Liaison Group on Urban Storm Drainage, comprising a correspondence network of people in more than 30 countries. The objective of both the Joint Committee and the Liaison Group is to promote international cooperation and development on the science and technology in urban storm drainage.

News & Announcements

Hydrology at the Spring Meeting

Mesoscale Precipitation Fields

A special, full-day session on "Investigation of Mesoscale Precipitation Fields" is being organized by the precipitation committee of AGU's Hydrology Section for the 1984 AGU Spring Meeting under the joint sponsorship of the Hydrology and Atmospheric Sciences sections. This session will contain about 10 invited talks by hydrologists, atmospheric scientists, statisticians, and mathematicians, with a new focus on interdisciplinary research in modeling precipitation fields. In the evening, a 2-hour panel discussion will be held to explore in depth the scope of interdisciplinary research and climatic variability. For additional details contact: Vijay K. Gupta, Dept. of Civil Engineering, Univ. of Mississippi, University, MS 38677 (telephone 601-232-5366).

Hillslope Hydrology

The Surface Runoff Committee is sponsoring a session on Hillslope Hydrology for the 1984 AGU Spring Meeting. Invited speakers include scientists from Australia, Canada, Germany, and the United States. For further details contact: Peter Germann, Dept. of Environmental Sciences, Univ. of Virginia, Charlottesville, VA 22903 (telephone 804-924-0558).

Solute Transport in Groundwater

Two symposia on solute transport in groundwater, both sponsored by the Hydrology Section's Groundwater Committee, will be held at the 1984 AGU Spring Meeting. A full-day session on "Miscible and Immiscible Transport in Groundwater" will feature a panel discussion as well as invited and contributed papers. Panel members include: Emil Frind, Lynn Gelhar, Bob Greenkorn, Fred Molz, and George Pinder. A tentative list of speakers includes: L. Abriola, Y. Corapcioglu, J. Cushman, C. Faust, L. Gelhar, W. Gray, O. Guven, D. Hochmuth, B. Lewis, G. Pinder, J. Rubin, F. Schwartz, L. Smith, and D. Sunada. For more information call Jim Mercer, GeoTrans, at 703-435-4400, or Leonard Konikow, USGS, Reston, at 703-860-6892.

A half-day session on "Field Methods for Supporting Chemical Transport Models" will provide a follow-up to the theoretical discussions featured in the companion symposium. A tentative list of invited speakers includes: Chin Fu Tsang, Joel G. Melville, Daniel B. Stephens, R. William Nelson, David Fryberg, and Edward Sudicky. For more information contact Fred Molz, Auburn Univ., at 205-826-4326 or Mary Anderson, Univ. of Wisconsin–Madison, at 608-262-2396.

History of Hydrology

"History of Hydrology: Earth Science Aspects" is the subject of a half-day symposium at the 1984 AGU Fall Meeting (December 3–7, 1984, San Francisco). The symposium is being organized by the new History and Heritage of Hydrology Committee (HHHC) of AGU's Hydrology Section (a committee which will also function as a subgroup of the AGU Committee on the History of Geophysics). The symposium will cover historical aspects of the geological and geochemical study of surface and groundwater. Because this is a first-time effort by the HHHC, no initial restrictions on scope have been imposed in order to span a range of interests and to identify a population of individuals with historical interests within AGU and the hydrology community in general.

Areas of interest might include the work of individual scientists, the evolution of concepts, and the development of techniques and methodologies. Persons interested in presenting a paper are encouraged to contact the symposium coordinator, Edward R. Landa, U.S. Geological Survey, 413 National Center, Reston, VA 22092 (telephone 703-860-6971).

Urban Hydrology

Storm Drainage

The Third International Conference on Urban Storm Drainage will be held in Goteborg, Sweden, June 4–8, 1984. Contact A. Sjoborg, Chalmers Univ. of Technology, Goteborg, Sweden, for more information. The Fourth Conference will be in late August 1987 in Lausanne, Switzerland, and the Fifth Conference is planned for Tokyo in 1990.

The proceedings of the First International Conference, held in Southampton, England, in April 1978, are available from Wiley-Interscience under the title "Urban Storm Drainage." The proceedings of the Second International Conference, held in Urbana, Illinois, in June 1981, are available from Water Resources Publications, Littleton, Colo., under the title, "Urban Stormwater Hydraulics and Hydrology" and "Urban Stormwater Quality, Management, and Planning."

Drainage Models

Under the cosponsorship of the IAHR/IAWPRC Joint Committee, an international symposium on the Comparison of Urban Drainage Models with Real Catchment Data will be held in September 1985 in Yugoslavia. Contact C. Maksimovic or M. Radojkovic, Inst. of Hydraulic Engineering, Bulevar Revolucije 73, Belgrade, Yugoslavia. The IAHR 21st Congress, in August 1985 at Melbourne, Australia, will hold a seminar on Urban Hydraulics. American contributions to both meetings are sought.

Sewerage Systems

An international Conference on the Planning, Construction, Maintenance, and Operation of Sewerage Systems is being organized by BHRA and will be held in Reading, England, September 12–14, 1984.

Stochastic Hydraulics

The Fourth IAHR International Symposium on Stochastic Hydraulics, cosponsored by AGU and the American Society of Civil Engineers, will be held July 31–August 2, 1984, at Urbana, Ill. About 40 papers selected from submitted abstracts will be presented in the symposium.

Topics covered will include (but not be limited to) the following areas: risk and reliability analysis; safety of dams and other hydraulic structures; stochastic models; and stochastic processes of hydraulic and hydrologic phenomena such as turbulence, sediment transport, dispersion and diffusion, and random waves.

Reasonably priced housing is available. Contact B. C. Yen or Glenn Stout, Hydrosystems Laboratory, Univ. of Illinois, 208 North Romine St., Urbana, IL 61801 (telephone 217-333-0897 or 217-333-0536).

1984 IAHS Symposia

Land Subsidence

The Third International Symposium on Land Subsidence, Venice, Italy, March 19–25, 1984, will offer 75 oral papers and 20 poster papers. A 1-day field trip by boat in the Lagoon of Venice has been scheduled for March 21. A 2-day field trip from Venice south to subsiding areas near Ravenna and Modena is scheduled for March 24–25, following the symposium papers sessions. For further information contact A. Ivan Johnson, General Cochairman, TISOLS, Woodward-Clyde Consultants, 7600 East Orchard Rd., Harlequin Plaza North, Englewood, CO 80111, USA.

Karst Water Resources

An International Symposium on Karst Water Resources, is scheduled for July 7–19, 1985, in Ankara and Antalya, Turkey. Subjects that may be considered for the symposium include hydrogeology, geochemistry, modeling, laboratory testing, tracer techniques, geophysics and other exploration methods, land subsidence and sinkhole formation, remote sensing techniques, groundwater and surface-water hydraulics and interpretation, engineering properties and problems, water-supply estimation, irrigation potential and irrigation practice.

Turkey provides an especially appropriate location for the symposium because of the quantity, variety, and importance of the karstic areas found there. The symposium is being sponsored by the Karst Water Resources Research Center Project of Hacettepe University, United Nations Development Program, United Nations Technical Cooperation Department, and the Turkish State Hydraulic Works. Cooperators will be the Turkish National Committee for the International Hydrological Program, the International Association of Hydrological Sciences, and other international technical societies and United Nations organizations.

Notice of intent to offer a paper or to attend the symposium should be sent to A. Ivan Johnson, Woodward-Clyde Consultants, 7600 East Orchard Rd., Harlequin Plaza North, Englewood, CO 80111, USA, or to Gultekin Gunay, Hydrogeological Engineering Dept., Hacettepe Univ., Engineering Faculty, Beytepe, Ankara, Turkey. They will send details on symposium arrangements and preparation of abstracts.

Hydrochemical Balances

The International Symposium on Hydrochemical Balances of Freshwater Systems, will be held in Stockholm, Sweden, September 10–14, 1984. For further information contact M. Falkenmark, Secretary, NFR's Committee for Hydrology, Box 6711, S-11385 Stockholm, Sweden.

EOS
Transactions, American Geophysical Union
The Weekly Newspaper of Geophysics

For speediest treatment of contributions send three copies of the double-spaced manuscript to one of the editors named below and one copy to AGU.

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Cover. View from Volcanological Observatory of Rabaul Caldera (Blanche Bay), last erupted about 1,400 years ago. The low point of land on the left center is Matupit Island, site of approximately 1 m of uplift over the past 13 years. On the right is Vulcan, which erupted explosively in 1937 and again in 1941. Ground deformation and seismic activity may indicate the rise of magma beneath the center of the caldera. The town of Rabaul and all settlements fringing Blanche Bay lie in the area of highest risk should an eruption occur. A stage-2 volcano alert was declared on October 29, 1983, in response to the increased seismic activity and ground deformation observed in September and October. Seismic activity was concentrated near Tavurvur volcano in early November but activity then increased near Vulcan later in the month. Tavurvur and Vulcan erupted together in 1937. Monitoring and development of emergency plans continues. (Photograph by Stanley N. Williams, Department of Earth Sciences, Dartmouth College, Hanover, NH 03755.)

Rocks of Low Permeability

The 17th International Congress of the IAH (International Association of Hydrogeologists) will meet in Tucson, Ariz., January 7–10, 1985. The deadline for abstracts is March 1, 1984, and final papers are due October 15, 1984.

The topic of the congress will be "Hydrogeology of Rocks of Low Permeability," and speakers will include W. Back, J. F. Bredehoeft, G. de Marsily, J. E. Gale, P. Fritz, L. W. Gelhar, G. E. Grisak, C. W. Kreitler, M. R. Llamas, T. N. Narasimhan, I. Neretnieks, and E. P. Weeks. The congress will conclude with a panel discussion moderated by S. P. Neuman. Panelists include S. N. Davis, G. de Marsily, R. A. Freeze, P. A. Witherspoon, and I. Neretnieks.

The Chairman of the Technical Program Committee is S. P. Neuman, Dept. of Hydrology and Water Resources, Univ. of Arizona, Tucson, AZ 85721, USA (telephone 602-621-7114 or 5082).

Field trips will follow the formal presentations on January 11 and 12. In addition a field trip to the Nevada Test Site is scheduled for January 14.

Salt Lake at Record Levels

Utah's Great Salt Lake rose 1.6 m between September 1982 and June 1983, the greatest seasonal rise measured in 136 years of record, according to a report published by Ted Arnow, chief of the U.S. Geological Survey (USGS) Water Resources District Office in Salt Lake City. The lake, which continued to rise after Arnow wrote his report, rose 25 cm in December, a record for a 1-month period. On January 1 the lake's height was measured at 1282.05 m above sea level, the highest since 1887.

The combined effects of above average rainfall in 1982, above average snowfall in the autumn of 1982 and the spring of 1983, and unseasonably cool weather during the spring of 1983 led to the record rise.

By mid January the lake's continued rise had cost $250 million in damages and in damage-prevention efforts. Flooding threatened to cut off Interstate Highway 80 and three transcontinental railroads.

Both the level and quality of the water in Great Salt Lake fluctuate continuously, according to Arnow. "The changes are primarily in response to changing climatic conditions, but man's activities have a lesser but still important effect." Since 1959, the lake has been bisected along its east-west axis by a railroad causeway that restricts natural circulation. This produces an elevation difference between the north and south sections; last year the southern section was at times almost 1 m higher than the northern section.

The northern section is saltier (25% salinity) than the southern part (9% salinity). (Seawater is considered to have a salinity of 3.5%.)

Copies of the report, *Water-Level and Water-Quality Changes in Great Salt Lake, Utah, 1847–1983* (USGS Circular 913), are available from the USGS Public Inquiries Office, 125 South State St., Salt Lake City, UT 84138.

Issues and Conditions Summarized by USGS

A chronology of recent significant hydrologic events, a state-by-state analysis of water conditions, and key water policy issues are described in two reports published earlier this year by the U.S. Geological Survey (USGS).

In its 243 pages, the report *National Water Summary 1983: Hydrologic Events and Issues* highlights water issues and related activities in all 50 states, the District of Columbia, Puerto Rico, the U.S. Virgin Islands, and the western Pacific islands under U.S. jurisdiction. Four concerns are addressed in this state-by-state analysis: water availability, water quality, hydrologic hazards and land use, and institutional and management issues. A chronology of significant hydrologic events between January 1982 and August 1983 is also included in the report. Copies are available for $9 each from the Branch of Distribution, Text Products Section, USGS, 604 South Pickett St., Alexandria, VA 22304. Orders must specify water supply paper 2250 and must include a check or money order made payable to the Department of the Interior/USGS.

Six policy issues are identified and discussed in the second report, *Water in America 1983*: river management improvement, interstate water conflicts, water project development, Indian water claims, and water quality as it relates to acid rain and to salinity. The 20-page report also focuses on the changing roles of the federal, state, and local authorities. Copies should be requested from the Director, Office of Policy Analysis, Department of the Interior, Washington, DC 20240.

Meeting Reports

Groundwater Management Modeling

The symposium on Optimization Techniques for Managing Groundwater and Stream-Aquifer Systems, held at the 1983 AGU Fall Meeting, covered (1) small-scale optimal design of well fields which were for the most part associated with the containment of contaminated groundwater, and (2) use of management models to evaluate conjunctive-use and water allocation policy. The presentations focused on methodology and case studies which have combined groundwater flow (and contaminant transport) simulation with linear and nonlinear optimization.

The 8 presentations and panel discussion brought together those who have largely shaped the field of groundwater management modeling and those who have extended and applied earlier methods and made contributions as part of recent or ongoing thesis work. After the formal presentations, Mantouch Heidari chaired the lively panel which consisted of Nathan Buras, John D. Bredehoeft, Yacov Y. Haimes, Thomas Maddock III, Gerald T. O'Mara, and Robert Willis.

Three topics of key interest dominated the audience's questions and the discussion: What is the purpose of groundwater and conjunctive-use management modeling? How can such models be effectively utilized? Can parameter uncertainty be better incorporated into the management-modeling methods? The discussion emphasized the importance of the simulation-management method as a tool to aid in understanding the physical as well as economic controls of stream-aquifer resource utilization, rather than as a technique for hydrogeologic engineering design.

This meeting report was prepared by Steven M. Gorelick, *who is with the U.S. Geological Survey, Menlo Park, CA 94025.*

Transport Processes of Excessive Sediment

The session on Transport Processes of Excessive Sediment Loads at the 1983 AGU Fall Meeting featured an excellent summary by H. W. Shen of the general points of the prevailing theories of transport mechanisms of high sediment loads, including both U.S. and Chinese work on the topic. The session attracted interesting papers and a good audience. The panel discussion after the papers was quite lively and contributed to the general understanding of the topic. Ray Krone gave a status report on the work of the American Society of Civil Engineers on excessive sediment loads, and guidelines for flood insurance for mud-flood events was discussed.

The field reports pointed out the important differences in the types and mechanics of flows in different areas. For example, the influence of geology on the flows in the Los Angeles area compared with the Mt. St. Helens area was quite striking. The schedule did not permit extended discussion of the theory papers. From the success of this session it appears that excessive sediment loads will be a lively topic for several years.

This meeting report was prepared by Karen L. Prestegaard, *Franklin and Marshall College, Lancaster, PA 17604.*

Orinoco and Amazon

Although much of the research being done on these rivers is still in its early stages, the misprint in the 1983 AGU Fall Meeting abstracts issue of *Eos* (November 8, 1983, p. 697) appears to be correct: These rivers are topical as well as tropical. The series of papers by Meade, Nordin, Dunne, and Mertes provided some interesting observations (for example, the rivers exhibited complicated longitudinal variations in sediment storage).

R. F. Stallard presented an excellent paper on mixing in large tropical rivers. The Orinoco and Amazon Rivers have fairly low sinuosities, and high width/depth ratios. These characteristics might be responsible for the observations made by Hiltero and Stallard that the tributary water chemistry is not mixed across the main channel for distances of several hundred kilometers.

The research on these large rivers illustrated that large rivers do not behave simply as up-scaled versions of smaller rivers. The importance of large rivers as water and hydroelectric power resources as well as the importance of the Amazon Basin vegetation as a storage reservoir for carbon dioxide makes research on these rivers quite important.

This meeting report was prepared by Karen L. Prestegaard, *Franklin and Marshall College, Lancaster, PA 17604.*

On The Waterfront

John L. Wilson has accepted a professorship at the Department of Geoscience, New Mexico Institute of Mining and Technology, Socorro, N. Mex.

Frank W. Schwartz has been named the 1981 Birdsall Lecturer. The Birdsall Lecture Series is sponsored by the Hydrogeology Division of the Geological Society of America.

David A. Stephenson has joined Water Resources Associates in Phoenix, Ariz.

Books

Atmosphere, Weather, and Climate

R. G. Barry and R. J. Chorley, 4th ed., Methuen, New York, xxii + 407 pp., 1982.

Reviewed by J. T. Houghton

The fourth edition of this book, first published in 1968, is to be welcomed. It is widely used in geography courses in schools and universities and has had considerable success in introducing, with the minimum of mathematics, synoptic and dynamic meterology and climatology into such courses. Its chapters cover atmospheric composition and energy, atmospheric moisture, atmospheric motion, air masses, fronts and depressions, weather and climate in temperate latitudes, tropical weather and climate, small scale climates and climatic variability, trends and fluctuations.

The main changes in the fourth edition have been in the last two chapters, which have been substantially rewritten. The chapter on small-scale climates goes into considerable detail concerning the energy balance over different surfaces and also discusses the influence of pollution and urban conditions on the local climate. The first chapter on climate variability and change first presents evidence for climate change in the past and then briefly mentions, with virtually no discussion, a few possible causes of climate change. The possible influence of the ocean, for instance, is given only four sentences!

Since the first edition of the book, there have been great advances in the modeling of climate through global general circulation models and a large amount of interest in the oceans as an important component of the climate system. It is a pity that the opportunity of this new edition was not taken to describe modeling techniques (the word model hardly occurs) and to expound a few of the results, for instance those associated with the influence of ocean temperatures or with increase in carbon dioxide.

A more minor issue concerns units. Calories are still extensively used in the book. Would it not be less confusing to the student and in line with international recommendations if watts were employed throughout?

J. T. Houghton is director general of the Meteorological Office, Bracknell, Berkshire, RG12 2SZ U.K.

Classified

POSITIONS AVAILABLE

Assistant Professor of Geophysics/Purdue University. The Department of Geosciences, Purdue University anticipates an opening for a new tenure track position at the assistant professor level in the area of exploration geophysics. The successful applicant must be prepared to assist in teaching exploration geophysics courses, advanced topics in his/her specialty and demonstrate an ability to develop and conduct productive research. Postdoctoral or industrial experience is desirable. The geophysics program in the Department of Geosciences at Purdue University currently consists of four full time geophysics faculty. Field and laboratory equipment and facilities are available for application to seismological and potential field geophysical methods. Excellent computing facilities including a Cyber 205 computer operated by Purdue University and mini-computers within the Department of Geosciences are available.

Send letter of application including brief description of research interest and goals, resume and names of three references to:

Don W. Levandowski, Department of Geosciences, Purdue University, West Lafayette, Indiana 47907.

Closing date for acceptance of applications is May 1, 1984 or until the position is filled.

Purdue University is an equal opportunity/affirmative action employer.

University of New Mexico/Paleomagnetism. The Department of Geology of The University of New Mexico invites applications for a tenure track full-time position as an Assistant Professor with a specialty in paleomagnetism beginning Fall 1984. The successful candidate will be expected to maintain an active research program and teach at the undergraduate and graduate level. The Department has sixteen full-time faculty, is located in a spectacular natural setting and has excellent analytical facilities.

Applicants should submit a resume, transcripts, and three letters of recommendation to R. Ewing, Department of Geology, Albuquerque, New Mexico 87131. The deadline for applications is April 10, 1984.

The University of New Mexico is an equal opportunity/affirmative action institution.

Research in Space Plasmas, Solar and Heliospheric Physics. The National Research Council offers Resident Research Associate awards in many areas of research; in particular, awards are available at the Jet Propulsion Laboratory in the area of Space Plasma Physics and Solar and Heliospheric Physics, as well as other areas. Areas of research available at JPL include studies of the solar wind, cometary plasma interactions, solar oscillations, magnetospheres of the Earth, Jupiter, and Saturn, plasma wave both in the solar wind and the magnetosphere, and the numerical modeling of space plasmas.

For further information about research opportunities at JPL in these research areas, please contact any of the individuals listed below:

Bruce E. Goldstein (213) 354-7366
Marcia Neugebauer (213) 354-2005
Edward J. Smith (213) 354-2248
Bruce T. Tsurutani (213) 354-7559

All individuals at Jet Propulsion Laboratory, Mail Stop 169-506, 4800 Oak Grove Drive, Pasadena, CA 91109.

Awards are available both at the postdoctoral (Regular) level and the Senior Research Associate level. Awards are initially for a period of one year, on some occasions an extension is allowed. Awards to Senior Associates are generally for one year but shorter periods will be considered.

Detailed information on application procedures, all necessary forms and a list of supporting documents required are available upon request from:

Associateship Programs (JH-608-H)
National Research Council
2101 Constitution Avenue, N.W., Washington, D.C. 20418

Space Plasma Theoretician/Princeton University. A postdoctoral position is available beginning summer of 1984 in the Theoretical Division of the Plasma Physics Laboratory, Princeton University, for one year with the possibility of renewal for a second year. Physicists with a Ph.D. degree or its equivalent or other relevant discipline are encouraged to apply. The position involves theoretical and numerical simulation studies on space plasma physics under the support of the National Science Foundation. Interaction with the members of the Laboratory engaged in fusion plasma physics is encouraged. Interested candidates should send a resume and three letters of recommendation to Dr. H. Okuda, Plasma Physics Laboratory, Princeton University, Princeton, NJ 08544.

Princeton University is an equal opportunity/affirmative action employer.

University of Kentucky. The Department of Geology invites applications for two tenure track faculty positions. Areas of specialization are: 1) Geophysics; 2) Structural or Tectonic geology with some emphasis on geochemistry, geophysics, geomathematics or petroleum geology. It is anticipated that both positions will be filled at the level of Assistant Professor but applications for a more senior person will be considered. Degree of Ph.D. is required.

The Department awards BS, MS, and PhD degrees. The starting rank and salary depends on qualifications and experience—either industrial or academic.

Letters of application should include a full curriculum vitae, a statement of intent regarding research, names of three referees, and should be addressed to: Dr. Nicholas Rast, Chairman of Search Committee, Bowman Hall, Room 253, University of Kentucky, Lexington, KY 40506–0036, (606) 257-6222. *DEADLINE* for application is *APRIL 15, 1984.*

The University of Kentucky is an affirmative action and equal opportunity institution.

Faculty Position/University of South Alabama. The Department of Geology and Geography is seeking to fill a tenure-track position at the Assistant Professor level, beginning September, 1984. Applicants should have major training and experience in geological application of remote sensing, and some phase of economic geology. The Ph.D. degree is required. This is a growing department with a present full-time faculty of five geologists and four geographers and approximately 200 majors. Please send resume and arrange for three letters of reference to be sent to: Dr. Glenn R. Sebastian, Chairperson, Department of Geology and Geography, University of South Alabama, Mobile, AL 36688. Applications should be sent before May 15, 1984.

The University of South Alabama is an equal opportunity, affirmative action employer.

University of South Alabama. Faculty Position. Tenure-track position at the rank of Assistant Professor in one of the two following fields: (1) Invertebrate Paleontology-Stratigraphy; (2) Igneous OR Metamorphic Petrology. The University of South Alabama has approximately 10,000 students, and is located in a growing metropolitan area. The Department of Geology and Geography has approximately 200 majors, and a faculty of nine full-time and three part-time members. This position is to be filled commencing September, 1984. The deadline for applications is May 15, 1984. Please submit letter of application, along with a resume of your education and experience, to: Dr. Glenn R. Sebastian, Chairperson, Department of Geology and Geography, University of South Alabama, Mobile, AL 36688. Also arrange to have at least three letters of reference sent to the same address.

The University of South Alabama is an equal opportunity, affirmative action employer.

Clay Mineralogy/University of Illinois at Urbana-Champaign. The Department of Geology invites applicants for a tenure-track faculty position in clay mineralogy. We are seeking candidates who have clearly demonstrated the potential to be outstanding researchers in the general areas of mineralogy, crystallography and chemistry of clay minerals, in the origin, diagenesis, and metamorphism of argillaceous sediments and whose future research will complement our existing programs in the petrology and diagenesis of sediments, experimental studies of compaction and of kinetics of burial diagenesis, behavior of clay minerals during deformation, petroleum geology, and stable isotope geochemistry. In addition to the development of a strong research program, the successful candidate is expected to participate in all aspects of teaching and advising at the graduate and undergraduate levels.

The Department of Geology houses a variety of facilities for clay mineralogy research, including x-ray diffraction and fluorescence units, an atomic absorption spectrophotometer, two NMR spectrometers, an isotope-ratio mass spectrometer, and electron microprobes. Numerous other analytical services are available on campus, particularly at the Materials Research Laboratory where there is equipment for Auger electron spectrometry, x-ray photoelectron spectrometry, scanning electron microscopy, transmission electron microscopy, and ion microprobe studies.

This position is available immediately. PhD. is required. Rank and salary will be commensurate with experience and qualifications. For equal consideration, please submit a letter of application that includes a statement of current and future research interests as well as a curriculum vitae, bibliography and the names of at least 3 references willing to comment on your qualifications and promise by April 1, 1984 to Dr. Albert V. Carozzi, Chairman, Search Committee, Department of Geology, 245 Natural History Building, 1301 W. Green Street, Urbana, IL 61801. Phone: 217/333-3008.

The University of Illinois is an equal-opportunity/affirmative action employer.

Faculty Position/Florida Atlantic University. The Physics Department is soliciting applications for an experimental physicist in a tenure line position at the Assistant Professor level beginning August, 1984.

Candidates must have a Ph.D. degree and have demonstrated a commitment to research and teaching. Preference will be given to candidates with experience in experimental atmospheric physics, optics, or solid state physics.

Salary is negotiable. Deadline for applications—April 1, 1984. Contact Dr. Bjorn Lamborn, Chairman, Department of Physics, Florida Atlantic University, Boca Raton, FL 33431, Tel (305) 393-3381.

Florida Atlantic University is an affirmative action/equal opportunity employer.

Marine Geology and Geophysics/University of Washington. The School of Oceanography is seeking candidates for a position as Research Assistant Professor, but applications at a more senior level will be considered. Preference will be given to a candidate who has research interests in marine geology and geophysics and who will interact with our ongoing research projects, especially in the area of ridge-crest processes. Although this position will eventually be funded through self-generated research grants, partial financial support is available for the first two years. Teaching requirements will be limited and at the graduate level. For consideration, send a resume, a brief letter describing research interests, and four letters of reference by 1 May 1984 to:

Professor Brian T.R. Lewis
Director
School of Oceanography, WB-10
University of Washington
Seattle, WA 98195

The University of Washington is an affirmative action/equal opportunity employer.

New Mexico Institute of Mining & Technology. New Mexico Institute of Mining & Technology has a vacancy for a permanent full-time research physicist. Work locations would be Workman Center on New Mexico Tech's campus on top of South Valdi near Langmuir Laboratory in the Magdalena Mountains of Central New Mexico, 17 miles southwest of Socorro. Duties will include the operation and maintenance of lightening measuring instruments in two KIVAS; experiment causing lightening channels to connect to sensor mounted above KIVA II; reduction of data and preparation reports and scientific papers on results of research at the KIVAS. Contract administration, proposal writing and negotiating with agencies sponsoring research at the KIVAS; teaching, as appropriate, of academic classes in the College Division.

The successful candidate must have a Ph.D. or equivalent in physics or electrical engineering. Candidate needs to be competent in use of electronic and digital measuring equipment and of computational aids. Should have several years of professional work experience and be scientifically motivated. Send applications to: New Mexico Tech, Personnel Office, Brown Hall, Socorro, NM 87801.

An equal opportunity/affirmative action employer.

Geophysicist/University of Minnesota. The Department of Geology & Geophysics invites applications for a tenure track position in solid-earth geophysics beginning fall 1984. We seek a Ph.D. and preferably some postdoctoral experience. The field of interest is open but includes, for example, gravity/magnetics, global and regional tectonics and the physical state of the crust and mantle.

Present research programs in geophysics include geomagnetism and paleomagnetism, mineral physics at high pressures, and crustal seismology. We also emphasize the interconnectedness of geophysics with the in-house strong programs in auqueous and isotopic geochemistry, tectonics, and limnology.

Please submit a letter of application and attach a curriculum vitae, statement of research and teaching interests, a list of publications and the names of three to five references by March 15, 1984 to: Subir Banerjee, Department of Geology and Geophysics, 310 Pillsbury Drive, S.E., University of Minnesota, Minneapolis, MN 55455.

The University of Minnesota is an equal employment opportunity/affirmative action employer and encourages applications from qualified women and minorities.

Program Manager/Air-Sea Interaction. NASA Headquarters' Oceanic Processes Branch is seeking candidates for planning, developing and implementing a scientific research program utilizing satellite techniques in the general area of air-sea interaction. Specifically included is the use of satellite scatterometry to characterize the surface wind field, and the effect of surface winds on upper-ocean currents. Qualifications include 1) ability to communicate effectively, 2) demonstrated experience in conducting original research, 3) program management experience, and 4) knowledge of physical oceanography. GS 14/15, with salary ranges from $41,277 to $63,115, commensurate with experience/education. For further information regarding requirements and application procedures write to address below or phone 202-755-3687. Formal applications must be received by May 6, 1984.

NASA Headquarters, Code NHP, Washington, D.C. 20546.

An equal opportunity employer.

Immediate Openings for M.S. and Ph.D. Graduate Research Assistantships/Laboratory for Atmospheric Research, College of Engineering, Washington State University. Current research includes measurements of hydroxyl radical concentrations; biogenic sulfur and hydrocarbon emission rates; global chemical concentration in remote locations; investigations of atmospheric transport in complex surroundings; studies of pollutant-vegetation interactions. Write Mr. Bob Koppe, Laboratory for Atmospheric Research, Washington State University, Pullman, WA 99164.

WSU is an equal opportunity/affirmative action employer.

Colgate University. The Department of Geology at Colgate University anticipates one or more openings in the teaching faculty beginning in the Fall of 1984. These openings may include a full-time appointment renewable for a maximum of three years at the assistant professor level (Ph.D. required). A second position at the instructor level would involve primarily laboratory teaching. One position must be filled by a candidate capable of teaching undergraduate oceanography and/or physical geology. Areas of further expertise are presently less restricted and could include any of the following disciplines: Economic Geology, Engineering Geology, Geomorphology, Glacial Geology, Hydrogeology, or Marine Geology.

Applicants should submit resume and the names of addresses of three references to Dr. Bruce Selleck, Department of Geology, Colgate University, Hamilton, NY 13346. Closing date for applications is March 15, 1984.

Colgate University is an equal-opportunity/affirmative-action employer and especially invites applications from women and minorities.

Groundwater Hydrologist. Fulltime position Ph.D. in Civil Engineering or Geohydrology with one to five years experience or M.S. with eight to ten years experience. Duties will consist of developing groundwater quality research ideas, seek funding and complete funded project. Basic geohydrologic skills required with strong emphasis on chemical background. Modeling skills desirable. Applicant must demonstrate good oral and written communication skills, be interested in developing own ideas and in assisting in staff management. Send resumes to: James P. Gibb, Head, Groundwater Section, Illinois State Water Survey, Box 5050, Station A., Champaign, IL 61820. 217-333-0236.

The State of Illinois is an affirmative action/equal opportunity employer.

The University of Auckland, New Zealand. A Research Fellowship is available in the field of Geothermal Reservoir Modelling for one year with the probability of contiuation for at least two further years. Applicants should have a PhD in engineering or applied mathematics and some experience in reservoir modelling is desirable. Commencing salary up to NZ$27,847 per annum. Further information is available from Associate-Professor M.J. O'Sullivan, Department of Theoretical and Applied Mechanics, University of Auckland, Private Bag, Auckland, New Zealand. Applications close 31 March 1984.

Postdoctoral Position/Atmospheric Chemistry. A postdoctoral position is available for a person with a Ph.D. degree in chemistry (preferrably analytical or physical) or micrometeorology. The position involves the measurement of atmospheric acidity and the dry deposition of trace gases from towers and aircraft. The successful applicant will be expected to travel to a variety of field sites and to perform chemical analyses using ion chromatography. A facility with computer programming, the fabrication of research equipment, and careful chemical contamination-control would all be useful.

This is a two-year full-time position, with an annual salary of $15,000 during the first year, to begin in the summer of 1984. Interested persons should send a resume, names and phone numbers of three references, a statement of research interests, and any reprints to Barry Huebert, Department of Chemistry, Colorado College, Colorado Springs, CO 80903.

Colorado College is an equal opportunity employer.

Bureau of Mineral Resources, Geology & Geophysics: Research Scientist/Senior Research Scientists, Marine Geophysicists. The Division of Marine Geosciences and Petroleum Geology in the Australian Bureau of Mineral Resources, Canberra, has vacancies for Marine geophysicists (3 positions).

The principal research aims of the Marine Division are to define the regional geological framework, petroleum prospectivity and evolution of the sedimentary basins of Australia's extensive continental shelf and margins; further to develop new scientific concepts of basin structures and evolution of passive margins and also the active margins of the South Pacific. The main objective is the stimulation of on-going programs of offshore petroleum exploration. The Division is presently in the process of acquiring a research vessel and seismic processing centre.

The successful candidates should be experienced in multichannel seismic operations, in seismic structural and stratigraphic interpretation and in at least some aspects of geohistory analysis. Associated experience in other fields of marine geophysics and petroleum would be valuable but not essential.

Classification will be at Research Scientist or Senior Research Scientist level depending on the successful candidate's qualifications and experience.

Qualifications: A Ph.D. (or equivalent) in marine geophysics together with demonstrated research ability.

Salary: Research Scientist (RS)—$A24344-$A30038/Senior Research Scientist (SRS) $A31092-$A35806.

Conditions: Conditions of service include superannuation, long service leave, four weeks annual leave and removal expenses to Canberra. Permanent appointment is available to persons who are Australian citizens. A term engagement will be considered for persons not meeting this criterion.

Canberra, the national capital, is located approximately 280 km southwest of Sydney and has excellent educational, recreational and sporting facilities.

Applications together with full personal and professional details and the names of at least three referees should be sent to:

The Director
Bureau of Mineral Resources
GPO Box 378
Canberra ACT 2601
Australia.

Applictions close 16 March 1984.

Research Position/Department of Oceanography, University of British Columbia. Recent Ph.D. with experience in statistical methods and geophysical fluid dynamics sought to participate in the analysis and interpretation of data from an array of cyclesondes (profiling current meter, CTD systems) and current meters in the Strait of Georgia. The candidate should also have the potential of modelling the observations in terms of the non-linear low frequency motion of a stratified fluid of variable depth. The position is available as of 1 November, 1984, for a duration of one year and may be renewed for a second year; it will be filled at postdoctoral (*ca* $20,700) or research associate (up to *ca* $27,000) level according to the candidate's experience. In accordance with Canadian immigration requirements, priority will be given to Canadian citizens and permanent residents of Canada. Resumes and three letters of reference should be sent 1 July 1984 to Dr. S. Pond, Dept. of Oceanography, 6270 University Blvd., Vancouver, B.C., Canada V6T 1W5.

Planetary Geologist/Geophysicist: Jet Propulsion Laboratory, Earth & Space Sciences Division. The Planetary and Oceanography Section anticipates the availability of one or two fulltime, staff scientist research positions in the areas of planetary geology and geophysics. The rank of appointment is open, but applicants should be beyond the postdoctoral level with a demonstrated record of expertise and accomplishments in independent research and publication. We welcome applicants with interest in structural geology and geophysics as applied to the study of solid-body planets and natural satellites with emphasis on determining surface properties and processes on planetary objects using ground-base and spacecraft remote sensing data and applicable theoretical and experimental techniques. Applicants should send letter outlining their experience, professional goals, resume, and copies of pertinent publications to: Dr. William R. Ward, Manager, Planetology and Oceanography Section, Jet Propulsion Laboratory, 4800 Oak Grove Drive, Dept. L34, Mail Stop 249-104, Pasadena, CA 91109.

An equal opportunity employer m/f.

Research Position in Space Plasma and Auroral Physics. Two research positions at the level of assistant or associate research scientists are available in the Department of Physics & Astronomy at the University of Iowa for qualified candidates with a Ph.D. degree and experience in space plasmas and/or auroral physics. Present research in space plasma physics emphasizes analysis and interpretation of observations of magnetospheric plasmas using instrumentation on board earth-orbiting spacecraft in the IMP and ISEE Missions. The University of Iowa's global imaging instrumentation on the spacecraft Dynamics Explorer 1 is the source of an extensive data base of auroral images from high altitude at visible and ultraviolet wavelengths. Photometric observations are also available for other areas of research including the physics of the upper atmosphere and the global distribution of atmospheric ozone. The applicant should identify and describe areas of his or her expertise which can support experimental or theoretical investigations in space plasma physics and/or auroral physics. Salary and position will be determined by the applicant's qualifications and experience.

A resume and the names of three persons knowledgeable of applicant's experience should be forwarded to: L.A. Frank, Department of Physics & Astronomy, University of Iowa, Van Allen Hall, Iowa City, Iowa 52242.

The University of Iowa is an affirmative action/equal opportunity employer.

Postdoctoral Position/University of Washington. Research Associate (postdoctoral) with background in physical oceanography or atmospheric sciences and interests in dynamical aspects of climate variability. Term of appointment: one (1) year, renewable for a second year subject to the approval of the Council. Closing date: March 15, 1984. Send curriculum vitae and a list of four (4) references to Director, JISAO, c/o Department of Atmospheric Sciences, AK-40, University of Washington, Seattle, WA 98195.

An equal opportunity/affirmative action employer.

Assistant Professor. The Coastal Studies Institute of Louisiana State University, Baton Rouge, is inviting applications for a faculty position in Physical Oceanography. Candidate should have experience in the theoretical, numerical, or laboratory studies of the dynamics of marginal seas, straights, shelves, etc., and candidates should plan on developing an externally funded reserarch program with emphasis on, but not restricted to the above area. Send curriculum vitae, research interests and a list of references to: Stephen P. Murray, Coastal Studies Institute, LSU, Baton Rouge, LA 70803 or call 504-388-5301.

LSU is an equal opportunity employer.

Postdoctoral Position/Dalhousie University. A two-year position in the Oceanography Department is available for a person interested in marine geophysics. Specific work involves participation in heat flow studies across the margins of eastern Canada but broader opportunities also exist for self-motivated projects within the University or at Bedford Institute of Oceanography. A Ph.D. in geophysics and desire to work 1-2 mo/yr at sea are required. Experience with heat flow helpful but not essential. Send C.V. and names of two references to: Dr. K. E. Louden, Dept. of Oceanography, Dalhousie University, Halifax, NS, Canada, B3H 4J1.

Physical Oceanography/Skidaway Institute of Oceanography. A physical oceanographer with a Ph.D. is being sought to conduct research on the continental shelf. Preference will be given candidates with expertise in theoretical physical oceanography and who are interested in studying and modelling ocean-estuarine exchange processes and/or continental shelf circulation. Such studies will complement and guide experimental programs presently being conducted at the Institute. The selected applicant will be appointed at a level and salary commensurate with experience.

Interested persons are encouraged to submit a resume, the names of three individuals who can be contacted for reference purposes and a concise statement of research interests to: Dr. Jackson O. Blanton, (912)356-2457, Skidaway Institute of Oceanography, P.O. Box 13687, Savannah, GA 31416 before the deadline of March 30, 1984.

The Skidaway Institute of Oceanography is an equal opportunity/affirmative action employer.

Research Associates. The Department of Earth and Space Sciences at SUNY Stony Brook invites applications for a Research Associate position. Candidates should be experienced in application of Electron Microprobe and Analytical Electron Microscope techniques to geologic materials. The Department has a JEOL 200C Electron Microscope with EDS and will be purchasing a new Electron Probe in 1984. Duties will include equipment maintenance, instruction of graduate students on equipment use and research both independent and in conjunction with faculty. Familiarity with computers and Fortran programming required. A PhD is preferred. Salary is negotiable, but we anticipate a range of $18–23K.

Send letter of application, resume and names and addresses of three references by March 31, 1984 to: Dr. Steven Bohlen, Department of Earth and Space Sciences, SUNY Stony Brook, NY 11794.

SUNY Stony Brook is an equal opportunity/affirmative action employer. AK# 7-84.

Air Force Geophysics Laboratory Geophysics Scholar Program (1984–1985). The Air Force Geophysics Laboratory (AFGL) and The Southeastern Center for Electrical Engineering Education (SCEEE) announce that applications are invited for research appointments during the 1984–1985 year in the Geophysics Scholar Program. This program provides research opportunities of 10 to 12 months duration for selected Engineers and Scientists to perform research in residence at the AFGL, Hanscom AFB, near Boston, Massachusetts. Scholars will be selected primarily from such fields as Geophysics, Atmospheric Physics, Meteorology, Ion Chemistry, Applied Science, Mathematical Modeling using Computers, and Engineering.

To be eligible, candidates must have a Ph.D. or equivalent experience in an appropriate technical field. Some appointments may be confirmed prior to August 1984 so early applications are encouraged. All qualified applicants will receive consideration without regard to race, color, religion, sex, or national origin. Application Deadline for September Appointments: August 1, 1984. For further information and application forms contact: SCEEE, 1101 Massachusetts Avenue, St. Cloud, FL 32769 Telephone: (305) 892-6146.

SCEEE supports Equal Opportunity/Affirmative Action.

POSITIONS WANTED

Mineralogist Geochemist. 31, Dipl., Ph.D., German, US permanent-resident, visa. Lunar (impact, igneous rocks) and terrestrial, (sedimentation, metamorphous rocks) petrographical geochemical/geochronology, broad analytical experience (includes MS, INAA), research experience in US, English/French, fluent, impressive publication record, seeks employment in research, industry or publishing business, *no* geographical restrictions. Please contact: Dr. Reimold, Inst. f. Mineralogy, Corrensstr. 24, D-4400 Munster, FRG

STUDENT OPPORTUNITIES

Opportunity for Graduate Study in Igneous Petrology/Isotope Geochemistry—Southern Methodist University. The Department of Geological Sciences at Southern Methodist University in Dallas, Texas seeks outstanding individuals interested in a PhD program in igneous petrology and/or isotope geochemistry. The successful applicant should have a strong background in geology, chemistry, and mathematics and an interest in volcanic processes. Research will involve participation in a field-oriented petrological, geochemical, and isotopic study of Late Cenozoic volcanism in the Chilean Andes. For further details and applications please contact either:

Dr. R. S. Harmon (214) 692-3075
or
Dr. M. A. Dungan (214) 692-2752
Department of Geological Sciences
Southern Methodist University
Dallas, Texas 75275.

State University of New York at Buffalo/Assistantship Opportunities. The Department of Geological Sciences invites graduate applicants for Fall 1984. Graduate/Teaching assistantships offer a stipend up to $5500.00 for 10 months, plus tuition waiver. Special assistantships in geophysics, geochemistry-mineralogy, and glaciology carrying a 10-month stipend of $7200.00 plus tuition waiver are available. Additional summer support is possible. Applications can be obtained from the Department of Geological Sciences, 4240 Ridge Lea, Amherst, NY 14226, 716-831-3051. Deadline for receipt of all materials is March 30, 1984.

The State University of New York at Buffalo is an affirmative action/equal opportunity employer and invites applications from minority and women candidates. No person in whatever relation with SUNYAB shall be subject to discrimination on the basis of age, color, national origin, race, religion, or sex.

AGU

1983 Bucher Medal

John W. Handin

Citation

It is hard to think of any presentation of an award more pleasurable to give or more deserving of receipt. John Handin, this year's Walter H. Bucher Medalist, has been one of the most distinguished scientists in the Bucher tradition. John's research has been devoted to the application of mechanics to the understanding of the deformation of the earth's crust. He is the preeminent leader in experimental studies of rock deformation. Along with King Hubbert he put together the superb group of tectonophysicists at Shell's research labs in the 1950's and early 1960's. Since then, Texas A&M's outstanding Center for Tectonophysics, which originated with Handin, grew to its present excellence under his leadership.

Handin served in the U.S. Army in the artillery following graduation from the University of California, Los Angeles (UCLA), in 1942. After the war he went on to get his Masters and Ph.D. degrees at UCLA. His dissertation was on clastic sedimentary processes but, in a postdoctoral appointment with David Griggs, who had just arrived at UCLA, John turned his attention to experimentation on the deformation of rocks under confining pressure. Just as Bucher turned to models to explain some large tectonic enigmas, Handin performed experiments which have elegantly demonstrated the mechanical principles underlying field observations of ductility and faulting of rocks.

The classic set of papers on Yule Marble by Griggs, Turner, Handin, and Borg led to the first predictions of calcite fabric by Handin and Griggs based on the deformation mechanisms of calcite. This body of work provided much of the basis for the next 3 decades of experimental studies of the plastic deformation of rocks. His Geological Society of America memoir, *Rock Deformation*, with D. T. Griggs, was rich with new directions for research in the subject.

Handin's 1963 paper with colleagues Hager, Friedman, and Feather on the effect of fluid pressure on the fracture strength of sedimentary rocks was a milestone. Following Hubbert's and Rubey's theoretical argument, their experiments were such a clear and decisive demonsiration of the effect predicted by Hubbert and Rubey that their hypothesis was essentially proven.

John Handin has had an influence on his field disproportionate to his distinguished published work. For those of us fortunate enough to have worked with him, John has been the very model of a scientist. Integrity, commitment to exacting measurements and critical judgment of one's own ideas, the sine qua non of science, are a Handin specialty. Moreover, his papers are among the most lucid and concise in our field. John has a delightful knack for saying a great deal in a few well-chosen words. All these virtues would be quite unbearable if it weren't for the fact that John Handin is one of the kindest mentors and warmest friends that can be found.

The Walter H. Bucher Medal is given for Handin's striking and profound scientific accomplishments. Speaking for his colleagues and former students, his good friends, this award is richly deserved for that and for much more. Our science, the institutions he has served, his students and colleagues—whatever John Handin has touched is better for his contact.

Barry Raleigh

Acceptance

Walter Bucher helped my career long before I met him. His classic treatise, *Deformation of the Earth's Crust*, excited a generation of readers and taught it much about not merely the facts of nature but also the inductive methods of natural history that every geologist must learn above all. Recently Terry Engelder kindly found me a copy of that once-famous book. It must once have belonged to the great Charles Schuchert, for inside is pasted a letter written him by young Bucher out of gratitude for encouragement of pioneering work. When my friend and mentor, David Griggs, accepted this award a decade ago, he said of Bucher, "in me, as in his other disciples, he created the feeling that my thoughts were of great import to his understanding of the world." Grigg's followers became likewise devoted to him, and we still enjoy a very special kinship. In wonderful succession we learn and knowledge grows. I reckon professional life's dearest prize is the respect of one's peers, but teachers are uniquely rewarded by the achievements of their students.

I am reminded of a quieter time during the 1950's when our Union's entire membership could comfortably convene in the National Academy's small rooms on Constitution Avenue, and young scientists could freely mingle with the truly great. But hindsight of the good old days also reveals that the tools of our trade were crude, research funding of the geosciences was pitifully small, and our tiny band was overwhelmed by a host of challenging problems—some only just stirring, like preservation of a healthy environment and depletion of natural resources. The electronics revolution has given us high-speed digital computers and high-resolution instrumentation. Numerical modeling has become a powerful tool for testing hypotheses. Advances in data processing have rendered the overburden all but transparent. Even very slow crustal deformations are measurable in real time. As the dramatic growth of our Union attests, never has our science been more vigorous. Its future should be still brighter—if only civilization can survive.

As an experimentalist, I am especially pleased by this honor because laboratory work on bits of the crust is hardly glamorous. Experimentalists must not work alone, for without meaningful applications, usually following years behind, their data are useless. So, this happy occasion owes much to King Hubbert's advocacy of the integrated program of theoretical, experimental, and field research on rock deformation that has flourished for 30 years, first at Shell and later at Texas A&M. And so, owing not to false modesty but to the simple truth, I must accept this award on behalf of all the exceptionally talented collaborators who have loyally supported me and been my staunch friends in good times and bad.

Having spent most of the last 10 years in academic administration and virtually all my professional life in Texas, I am pleased too by the implications that scholarship and its fostering are both honorable and that reputable research can be done somewhere between the East Coast and West Coast and south of Chicago.

John Handin

Meetings

Geophysical Year

New Listings

March 26–29 Lectures on **Geophysical and Solar Activity Indices,** Han-Sur-Lesse, Belgium. Sponsor, Institut D'Aéronomie Spatiale de Belgique. (L. Bossy and J. Lemaire, Institut D'Aéronomie Spatiale de Belgique, 3, avenue Circulaire, B 1180 Bruxelles, Belgium.)

March 26–29 International Conference on **Groundwater Quality Research,** Tulsa, Okla. (Shari Dunn; Univ. Center for Water Research, Oklahoma State Univ., 203 Whitehurst, Stillwater, OK 74078; tel. 405-624-6095.)

April 9–11 Sixth Annual **Groundwater Heat Pump Conference,** Columbus, Ohio. Sponsor, National Water Well Association. (National Water Well Association, 500 W. Wilson Bridge Rd., Worthington, OH 43085; tel. 614-846-0355.)

April 24–26 Fourth Annual Front Range **Branch Hydrology Days,** Fort Collins, Colo. (H. J. Morel-Seytoux, Dept. of Civil Engi-

Meetings (*cont. on p. 70*)

Meetings (cont. from p. 69)

neering, Colo. St. Univ., Fort Collins, CO 80523; tel. 303-491-5148 or 8549.)

April 26–27 Sixth Annual Texas A&M Geodynamics Research Program Symposium on **Collision Tectonics: Deformation of Continental Lithosphere,** College Station, Tex. *Sponsors, Inter-Union Commission on the* Lithosphere, NASA, and the Commission on Marine Geophysics of IAPSO. (Texas A&M Geodynamics Office, College Station, TX 77843–3114; tel. 409-845-8177.)

April 30–May 4 Penrose Conference on Structural Styles and Deformational Fabrics *of* **Accretionary Complexes,** Eureka/Arcata, Calif. Sponsor, GSA. (Western Experience, 2450 Central Ave., Suite P-2, Boulder, CO 80303; tel. 303-449-3352.)

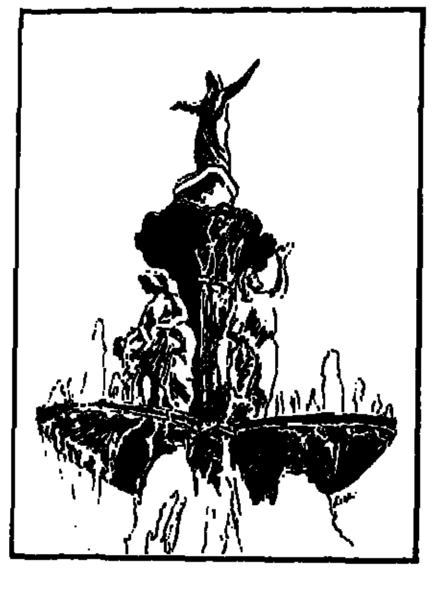
May 21–23 Ninth Conference on **Weather Modification,** Park City, Utah. Sponsor, American Meteorological Society. (Edward Hindman, Dept. Atmos. Sci., Colo. St. Univ., Ft. Collins, CO 80523, tel. 303-491-8311.)

May 23–25 Workshop on **Precipitation Enhancement,** Park City, Utah. *Sponsors,* National Science Foundation and American Meteorological Society. (Roscoe Braham, Dept. of Geophysical Sciences, Univ. of Chicago, Chicago, IL 60637; tel. 312-962-8123/8124.)

May 29–31 **Urban Water '84—A Time For Renewal,** Baltimore, Md. *Sponsor,* American Society of Civil Engineers Water Resources Planning and Management Division. (Harold Day, College of Environmental Science, University of Wisconsin at Green Bay, Green Bay, WI 54301; tel. 414-465-2250.)

The **Geophysical Year** calendar last appeared in the December 6, 1983, issue.

AGU Spring Meeting: Housing and Registration



The 1984 Spring Meeting of the American Geophysical Union will be held in Cincinnati, Ohio, May 14–18, at the Convention-Exposition Center. The center, located in the heart of the city, is an ideal meeting site; a skywalk *system links the Convention-Exposition Cen*ter with major downtown hotels, restaurants, and shops. Cincinnati is easily reached by three major highways and the Greater Cincinnati International Airport (only 15 minutes from downtown).

Registration

Everyone who attends the meeting must register. Preregistration received by April 20 saves you time and money. The fee will be refunded to you if AGU receives written notice of cancellation by May 7. Registration rates are as follows:

	Preregistration	After April 20
Member	$70	$85
Student Member*	$30	$45
Retired Senior Member**	$30	$45
Nonmember	$95	$110
Student Nonmember	$40	$55

*Student fee has been rolled back to 1982 rates.
**Age 65 or over and retired from full-time employment.

Registration for 1 day is available at one half the above rates, either in advance or at the meeting. Members of the American Congress on Surveying and Mapping, the American Meteorological Society, the American Society of Photogrammetry, the European Geophysical Union, and the Union Geofísica Mexicana may register at the AGU member rates. *If you are not a member of AGU* and you register at the full meeting rate, the difference between member (or student member) registration and nonmember registration will be applied to AGU dues will be waived if a completed membership application is received at AGU by July 9, 1984. To preregister, fill out the registration form, and return it with your payment to AGU by April 20. Preregistrants should pick up their *registration material at the registration desk* located in the Convention-Exposition Center. Your receipt will be included with your preregistration material. Registration hours are 8 A.M. to 4 P.M., Monday through Friday. On *Sunday, May 13, you may register* from 5:30 P.M. to 7:30 P.M.

Hotel Accommodations

Blocks of rooms are being held at the Clarion Hotel (formerly Stouffer's) *and at the* Netherland Plaza for those attending the Spring Meeting. The Clarion ($55 single, $65 double) is immediately adjacent to the Convention Exposition Center. The Netherland Plaza ($56 single, $66 double) is approximately three blocks from the Center, easily accessible *by the skywalk system.*

Hotel reservations must be received by April 16, 1984, to be confirmed. **Mail the completed housing form directly** *to the hotel* **of your choice. Do not write or telephone AGU for housing reservations.**

Scientific Sessions

The program summary will be published in the March 27 issue *of Eos. The preliminary* program with the abstracts will be published in the April 17 issue of *Eos.* The final meeting program, with presentation times, will be distributed at the Spring Meeting. Scientific sessions will be held at the Convention—Exposition Center.

Exhibits

Exhibits of instrumentation equipment, book publishers, programs of government agencies, and other organizations will run from Tuesday, May 15, to Thursday, May 17, 9 A.M. to 5 P.M. daily.

Special Events

An icebreaker party on Monday evening from 5:30 to 7 P.M. will be the opening social event of the meeting.

The Honors Ceremony, Reception, and President's Dinner in honor of the medalists, awardees, and Fellows will be held on *Wednesday evening, May 16.*

Complimentary refreshments will be served Monday through Friday at the Center, 9:15 to 11 A.M. and 2:30 to 4:15 P.M.

Business Meetings and Section Luncheons

The AGU Council will meet Tuesday, May 15, at 5:30 P.M. The annual business meeting of the Union will follow the Council Meeting. Members are welcome to attend. Section luncheons will be held at the Clarion Hotel; room locations will be published later. Please indicate on the registration form which luncheon you plan to attend and include payment.

The **Geomagnetism and Paleomagnetism** luncheon and the **Planetology/Volcanology Petrology,** and **Geochemistry** luncheon will be held on Monday, May 14.

The **Seismology** and **Tectonophysics** luncheons will be held on Tuesday, May 15.

The **Hydrology, Ocean Sciences,** and **Solar-Planetary Relationships** luncheons will be held on Wednesday, May 16.

The **Atmospheric Sciences** and **Geodesy** luncheons will be held on Thursday, May 17.

Refer to the registration form for cost.

RETURN THIS FORM WITH PAYMENT TO: Meeting Registration, American Geophysical Union, 2000 Florida Avenue, N.W., Washington, DC 20009

OR CALL: Toll Free 800-424-2488 or *Meetings* 202-462-6903

AGU 1984 SPRING MEETING
MAY 14–18
Cincinnati, Ohio
REGISTRATION FORM
Deadline for Receipt of Preregistration April 20, 1984

PLEASE PRINT CLEARLY

NAME FOR BADGE ______________________

AFFILIATION ______________________

MAILING ADDRESS ______________________

____

____

TELEPHONE NO. ______________________

HOTEL ______________________

Days you plan to attend:

Please check the appropriate box(es)
☐ Mon ☐ Wed ☐ Fri
☐ Tue ☐ Thu

Members of the cooperating societies, listed below, may register at AGU member rates.

Please check appropriate box:
☐ Member AGU ☐ Nonmember
Member cooperating society:
☐ AMS-American Meteorological Society
☐ ASP-American Society of Photogrammetry
☐ ACSM-American Congress on Surveying and Mapping
☐ EGU-European Geophysical Union
☐ UGM-Union Geofísica Mexicana

Nonmembers

If you register at the full-meeting rate, the difference between member (or student member) registration and nonmember registration will be applied to AGU *dues if a completed membership application* is received at AGU by July 9, 1984.

Preregistrants

Your receipt will be in your preregistration packet. The registration fee will be refunded if written notice of cancellation is received in the AGU office by May 7. The program and meeting abstracts will appear in the April 17 issue of *Eos,* and will be available at the meeting.

	More than one day	One day
MEMBER	☐ $70	☐ $35
STUDENT MEMBER*	☐ $30	☐ $15
RETIRED SENIOR MEMBER**	☐ $30	☐ $15
NONMEMBER	☐ $95	☐ $47.50
STUDENT NONMEMBER	☐ $40	☐ $20

*Student fees have been rolled back to 1982 rates
**65 or over and retired from full-time employment

SECTION LUNCHEONS

Circle section and indicate number of tickets. All lunches begin shortly after noon.

_____ Planetology/Volcanology, Geochemistry, and Petrology, Monday, $9.50
_____ Geomagnetism and Paleomagnetism, Monday, $7
_____ Seismology, Tuesday, $5
_____ Tectonophysics, Tuesday, $9.50
_____ Solar-Planetary Relationships, Wednesday, $9.50
_____ Hydrology, Wednesday, $9.50
_____ Ocean Sciences, Wednesday, $9.50
_____ Atmospheric Sciences, Thursday, $9.50
_____ Geodesy, Thursday, $7

Total Enclosed $ ____________
(All orders must be accompanied by payment or credit card information. Make check payable to AGU.)

Charge to: ☐ American Express
☐ VISA
☐ MasterCard

Card Number ____________

Master Card Interbank No. ____________

Expiration Date ____________

Signature ____________

AMERICAN GEOPHYSICAL UNION SPRING MEETING
MAY 14–18, 1984
HOUSING REGISTRATION FORM

PLEASE CHECK ACCOMMODATIONS

☐ Single (one bed, one person)

☐ Double bed (one bed, two persons)

☐ Twin beds (two beds, two persons)

SUITES UPON REQUEST

Check appropriate box and mail this form to preferred hotel

☐ Clarion Hotel
141 West 6th St.
Cincinnati, OH 45202
513-352-2100
$55 Single/$65 Double

☐ Netherland Plaza
35 West Fifth St.
Cincinnati, OH 45202
513-421-9100
$56 Single/$66 Double

Please Note: Reservations must be received by April 16 in order to be confirmed. All reservations received thereafter will be confirmed subject to availability.

Arrival Date ________ AM ☐ ________ PM ☐ ________
Departure Date ________ AM ☐ ________ PM ☐ ________
Name ____________
Address ____________
City ________ State ________ Zip ________
Company Name ____________
Shared with ____________
Address ____________
City ________ State ________ Zip ________
Company Name ____________

IMPORTANT NOTE: Hotel MAY require a deposit or some other form of guaranteed arrival. If so, instructions will be on your confirmation form.

GAP

Separates

To Order: The order number can be found at the end of each abstract; use all digits when ordering. Only papers with order numbers are available from AGU. *Cost:* $3.50 for the first article and $1.00 for each additional article in the same order. Payment must accompany order. Deposit accounts available.

Send your order to:
American Geophysical Union
2000 Florida Avenue, N.W.
Washington, D.C. 20009

Aeronomy

0460 Tides, Waves and Winds
A TWO-DIMENSIONAL, HIGH-RESOLUTION, NESTED-GRID MODEL OF THE THERMOSPHERE 1. NEUTRAL RESPONSE TO AN ELECTRIC FIELD "SPIKE"
T.J. Fuller-Rowell (National Center for Atmospheric Research, P.O. Box 3000, Boulder, Colorado 80307)
A two-dimensional, nested-grid model of the thermosphere with high resolution in the horizontal direction has been developed to study a number of dynamic, electrodynamic, and chemical problems at high latitudes. The model solves the time-dependent momentum, energy, continuity, and three-constituent composition equation of the neutral gas self-consistently, with the assumption of hydrostatic equilibrium. The grid network consists of a low-resolution, height/latitude slice stretching from the equator of one longitude sector, up to the pole, and down to the equator in the opposite sector. Imbedded within this mesh is a system of two nested grids to achieve a latitude resolution of 10 to 20 km. An initial simulation is presented to illustrate the response of the middle and upper neutral thermosphere to a narrow, 1 degree latitude, "spike" (100 mV m^{-1}) of electric field in the vicinity of the auroral oval. The simulation revealed a number of points: (1) The magnitude of the dynamic response to the westward ion convection channel was 30% greater than that resulting from an identical eastward channel, due purely to the earth's rotation; (2) Broadening of the latitudinal extent of the response, particularly on the equatorward edge of the channel, to the narrow primary sources of ion-drag and Joule heating was most effected by horizontal advection; (3) Horizontal heat conduction was important both within and near the edge of the convection channel; and (4) In regions where advection was weak, particularly at the poleward edge of the channel, horizontal viscosity made a significant contribution to a broadening of the response, and viscous dissipation provided an additional heat source. (Thermospheric dynamics, neutral wind, temperature and composition, nested-grid)
J. Geophys. Res., A, Paper 4A0139

4790 Instruments and techniques
COMPARISON OF PROFILING AND MOORED CURRENT MEASUREMENTS IN THE EQUATORIAL PACIFIC
R. Paul Freitag (NOAA Pacific Marine Environmental Laboratory, 7600 Sand Point Way NE, Seattle, Washington, 98115), and Eric Firing
Profiling current meter (PCM) measurements of near-surface equatorial currents are compared with concurrent moored current meter (MCM) measurements. RMS differences between the two are less than 15 cm s^{-1} when PCM measurements are referenced to 300 to 500 m and less than 10 cm s^{-1} when considered as relative velocity. The lack of an absolute reference level was the major contributor to differences in transport per unit width.
J. Geophys. Res., C, Paper 4C0200

Electromagnetics

0773 Remote Sensing
REMOTE SENSING OF WEATHER AND CLIMATE PARAMETERS FROM HIRS2/MSU ON TIROS N
J. Susskind (Goddard Laboratory for Atmospheric Sciences, Code 911, Goddard Space Flight Center, Greenbelt, Maryland, 20771), J. Rosenfield, D. Reuter, and M. T. Chahine
At the Goddard Laboratory for Atmospheric Sciences (GLAS) we have developed a physically based satellite temperature sounding retrieval system, involving the simultaneous analysis of *HIRS2 and MSU sounding data,* for determining atmospheric and surface conditions which are consistent with the observed radiances. In addition to determining accurate atmospheric temperature profiles even in the presence of cloud contamination, *the system provides global estimates of day and night sea or land surface temperatures,* snow and ice cover, and parameters related to cloud cover. The inverse radiative transfer equation approach to the multi-spectral analysis of the data, and details of its implementation, are described. Ice, snow, and cloud fields derived for January 1979 are consistent with other measures of similar parameters obtained from AVHRR and SMMR. Monthly mean sea-surface temperature fields agree with those derived from ship and buoy measurements to .5°C.
J. Geophys. Res., D, Paper 4D0169

Exploration Geophysics

0930 Seismic Methods
REPLY TO COMMENT ON "DETERMINATION OF IN SITU ATTENUATION FROM FULL WAVEFORM ACOUSTIC LOGS" BY L. ENGELHARD, TH. GROB AND F. NEUPERT
C.H. Chang, H.N. Toksöz and H.E. Willis[†] (Earth Resources Laboratory, Department of Earth, Atmospheric and Planetary Sciences, Massachusetts Institute of Technology, Cambridge, MA 02139; [†]now at: Mobil Research and Development Corp., Dallas, TX 75234)
In reply to the comments by Engelhard et al., we agree that in principal that the spectral ratio slope method is the more stable method to determine attenuation. However, on narrow band and ringy data, the spectral ratio slope method is unstable and often gives unphysical results. The spectral ratio peak method is better under these conditions. This is demonstrated by numerical examples generated using the discrete wavenumber summation technique. (attenuation, acoustic logging)
J. Geophys. Res., B, Paper 4B0055

Meteorology

3799 General (Earth Radiation Budget)
A CALIBRATION ADJUSTMENT TECHNIQUE COMBINING ERB PARAMETERS FROM DIFFERENT REMOTE SENSING PLATFORMS INTO A LONG-TERM DATASET
P.E. Ardanuy (Research & Data Systems, 10300 Greenbelt Rd., Lanham, MD, 20706) and H. Jacobowitz
Earth Radiation Budget (ERB) experiments on board the Nimbus-6 (ERB-6) and Nimbus-7 (ERB-7) spacecraft have measured Wide-Field-of-View (WFOV) total (.2 to 50 μm), shortwave (.2 to 3.8 μm), and near-infrared (.7 to 2.8 μm) terrestrial irradiances for a joint lifetime approaching eight years. Through the spectral characteristics of both experiments are nearly identical, instrument degradation and altitude differences introduce discrepancies between the two datasets. ERB parameters from these two observing platforms may only be combined into a scientifically meaningful dataset after these discrepancies are eliminated. To facilitate the creation of a long-term ERB dataset, comparisons of the ERB-6 experiment irradiances with, and calibrations with respect to, the corresponding ERB-7 irradiances have been performed. Two calibration methods were developed and applied to the irradiance data from 28 pairs of collocated orbits. The differential effects of altitude, illumination, albedo and scene inhomogeneities were applied. By making the irradiances of these two spacecraft compatible, a unique long-term dataset is created. This dataset has the potential of providing continuous (given the sampling frequency) global and regional budgets of longwave, shortwave and total radiation from the time when the Nimbus-6 ERB instrument was activated through that time when the Nimbus-7 ERB instrument is shut down. An extension of this technique, and this dataset, past 1984 becomes possible when the ERBE mission is considered.
J. Geophys. Res., D, Paper 4D0202

Mineralogy, Petrology, and Crystal Chemistry

4210 Crystal chemistry
SPECTRAL CHEMISTRY OF GREEN GLASS-BEARING 15426 REGOLITH
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The detection of appreciable concentrations of ferric iron in a synthetic green glass equilibrated at an oxygen fugacity of 10^{-11} atm prompted a Mossbauer spectral study of pristine emerald-green glass spherules carefully hand-picked from regolith sample 15426. No Fe^{3+} ions were detected in this lunar sample, or in a synthetic green glass simulant equilibrated at $fO_2 = 10^{-15}$ atm, suggesting that the green glass clots in rock 15426 formed under conditions of correspondingly low oxygen fugacities. The Mossbauer spectra indicated the presence of olivine crystallites in the lunar emerald-green glass spherules. Measurements of homogeneous and partially devitrified synthetic silicate glasses revealed that significant changes of coordination environment about Fe^{2+} ions in the glass structure occur during crystallization of olivine crystals from the melt. (Mossbauer spectra, green glass, 15426).
J. Geophys. Res., B, Paper 3B1018

4260 Paragenesis, petrography and petrogenesis
PETROLOGY OF YOUNG PACIFIC SEAMOUNTS
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Twenty-two young seamounts near the East Pacific Rise consist predominantly of Ol-Hy normative basalt chemically identical to depleted MORB. This basalt is systematically more primitive than the EPR lavas and is supplied directly to the seamounts from the mantle under the ridge, ridge-transform intersections and fracture zones. The seamounts also contain small volumes of differentiated basalt with low Mg# which fractionate from basalt parents of high Mg# mainly by processes of fractional crystallization. Seamounts also contain Ne-normative alkali basalts which are enriched in light rare earth, other incompatible trace elements and volatiles, as well as a complete spectrum of transitional basalts of intermediate composition. We suggest that this spectrum of primitive basalt types forms due to magma mixing during melt segregation in the region of melting of a chemically, isotopically, and perhaps mineralogically heterogeneous mantle. Melting probably takes place at about 100 MPa in the stability field of plagioclase or plag-spinel and the extent of partial melting is highly variable: relatively low to produce alkalic basalts and relatively high to produce the tholeiitic MORB. All basalt types, however, are probably hybrids produced by mixing in the region of melt segregation. The thermal and mechanical regime which results in the magma diversity observed on young seamounts is evident, also present at very slow spreading ridges but not below fast-spreading ridges. Normal ridge crest segments and fracture zones (seamount volcanism) thus exhibit a range of thermochemical characteristics which differ markedly from plume/hotspot volcanism. (Petrology, seamounts, chemical analyses, mantle chemistry).
J. Geophys. Res., B, Paper 3B0128

Oceanography

4213 Circulation
SATELLITE OBSERVATIONS OF CIRCULATION IN THE EASTERN BERING SEA
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Satellite infrared observations of the eastern Bering Sea shelf and basin were analyzed from *December 1979 to August 1981. A region of warm* surface water which extends from the Gulf of Alaska through the Aleutian Passes into the Bering Sea was observed coincident with a tract of [illegible] surface water and with eddies along the shelf break. The spatial and temporal relationships of these patterns imply a surface inflow through Unimak and other western Aleutian Passes, flow along the shelf break including eddies along the Bering Slope Current, and cyclonic flow in the [illegible] eddies along the shelf break include topographic interactions, baroclinic instabilities, and Rossby waves. (Circulation, eddies, Bering Sea)
J. Geophys. Res., C, Paper 4C0[illegible]

4765 Surface waves, tides and sea level
LONGSHORE STRUCTURE OF INFRAGRAVITY WAVE MOTIONS
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Synchronous runup records were collected from 14 locations spaced irregularly over a 2 km stretch of a low-slope beach. The significant runup height, herein defined as the significant vertical excursion of water level at the shoreline, was typically 2 m, 60% of the incident significant wave height at the breakpoint. The runup spectra were dominated by the energy at low frequencies, with 99.9% of the variance in motions with periods longer than 20 seconds and 83% for periods longer than 50 seconds. A peak between 0.005-0.010 Hz was present in all spectra. Analysis of this band showed the motion to be a standing edge wave with wavelength between 5-10 km and significant edge wave height at the antinode of 1.3 m, accounting for half of the local significant runup height. The edge wave period was approximately 140 seconds and the mode number in the range 3-7. An apparently linear sand bar was present 175 m offshore, roughly the same location as the first node of cross-shore velocity for the edge wave. While the edge wave could not have been the cause of the bar (a standing edge wave does not create a linear bar), the opposite may be true, with the bar potentially providing a topographic resonance. As the local headlands extend only a small fraction of the offshore distance of the edge wave, they are unlikely to be significant reflectors. The single rip current observed occurred at the edge wave node.
J. Geophys. Res., C, Paper 4C0219

4799 General (Polynyas)
KATABATIC WIND FORCING OF THE TERRA NOVA BAY POLYNYA
David H. Bromwich (Institute of Polar Studies, Ohio State University, Columbus, Ohio, 43210) and Dennis D. Kurtz
The Terra Nova Bay polynya is a perennial winter feature in the western Ross Sea, Antarctica which occupies roughly 1000 km^2. It is formed and maintained by the combined influence of persistent katabatic winds which advect newly formed bay ice eastwards, and the Drygalski Ice Tongue which prevents northward drifting pack ice from entering Terra Nova Bay. Existence of anomalously strong katabatic drainage along this coast is predicted by Parish's [1982] simulation of wintertime airflow which reveals a pronounced confluence of surface winds upslope from the Reeves Glacier where the winds are further focused by local topography. The simulation *is strongly supported by regional sastrugi orientations.* Average wintertime atmospheric conditions and ice sheet topography which control surface air drainage are stable on a climatic time scale, therefore persistent wintertime katabatic winds *should be an annual phenomenon. Further evidence* comes from multi-year Landsat images which consistently show windswept, snow-free areas on the Reeves Glacier. In marked contrast to typical Antarctic katabatic winds, strong persistent winter winds are observed at sea level ≈ 25 km beyond the coastal slope break. Air probably descends as bora-type winds and is likely to be significantly denser than the air at sea level; conditions are not favorable for hydraulic jumps apparently typical of other katabatic regimes. The horizontal density difference is maintained during airflow across the Reeves Ice Sheet because relatively little air mass modification occurs there in contrast to situations where air moves over an ice-laden ocean. Observations thus suggest that katabatic winds maintain their identity for some distance seaward of the coast; qualitative trajectory calculations indicate that for representative geostrophic conditions this distance is on the order of the observed polynya width. Estimated ice freezing rates are ≈ 20 cm d^{-1}, but wind-generated waves and currents prevent ice from consolidating. The blocking effect of the Drygalski Ice Tongue is a consequence of ice orientation with regard to western Ross Sea ice drift patterns, ice tongue length controls polynya width. Absence of such blocking along other coasts experiencing strong katabatic outflow partly explains why similar polynyas do not form there. (Polynyas, boundary layer windfields, sea ice).
J. Geophys. Res., C, Paper 4C0159

Particles and Fields—Magnetosphere

5720 Interaction between solar wind and magnetosphere
ENERGETIC PARTICLE TRANSPORT IN THE UPSTREAM REGION OF JUPITER: VOYAGER RESULTS
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Using Voyager 1 and 2 energetic (>30 keV) ion measurements near the magnetopause, in the magnetosheath, and immediately upstream of the Jovian bow shock, the available ion compositional patterns have been examined together with typical energy spectra in each of these regions. Field-aligned, highly anisotropic ion bursts [illegible] upstream events have relatively low fluxes of electrons and heavy ions associated with them. [illegible]
J. Geophys. Res., A, Paper 4A0[illegible]

5755 Plasma instabilities
WAVE PARTICLE TRANSPORT FROM DENSITY DRIFT INSTABILITIES: A COMPARISON OF LOCAL AND NONLOCAL THEORIES
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A plasma density gradient perpendicular to an ambient magnetic field is unstable to the growth of electrostatic waves. The objective of this paper is to describe the rate at which these density drift instabilities transport plasma across the magnetic field lines. This objective is accomplished as follows. The plasma density irregularity is represented as a Fourier series. Using linear plasma theory, the nonlocal dispersion equation is derived, relating the Fourier amplitudes to the eigenvalues (i.e., wave frequencies and growth rates) for the electrostatic fluctuations. For each complex eigenvalue, an electrostatic eigenmode is computed. These eigenmodes grow to saturation and are summed, yielding the total electrostatic turbulence. The flux of plasma across the magnetic field lines is computed from the turbulence. The transport derived from the nonlocal theory is compared with that derived using the less complicated local approximation. Wave-particle transport based on the local approximation is shown to be valid only in regions where variations in the density gradient are small.
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